

A Tensioning Device for strip-shaped Tension Members

The invention relates to a tensioning device for strip-shaped tension members on supporting structures, particularly concrete supporting structures, with a tensioning traverse that is detachably fastened to a base plate that is permanently fastened to the supporting structure, such that a prestressing anchor that is connected to the strip-shaped tension member by means of clamping, may be shifted by means of pressing elements for the purpose of tightening the tension member and may be supported against the tensioning traverse or the base plate.

To enhance (upgrade) the load-bearing capacity, or to restore the original load-bearing capacity of supporting structures made of steel-reinforced concrete (restoration), or pre-stressed concrete, the application of band-shaped tension members to the surface of the concrete after the fact is known. Lamella-like plastic strips, with embedded carbon fibers, for example, are used as tension members. For anchoring, base plates made of steel, for example, are pinned into recesses in the surface of the concrete and/or fastened by adhesion.

In order to apply the requisite pre-tension to the strip-shaped tension member prior to its permanent anchoring, a tensioning device is applied to one end of the tension member, which device is removed again after the tensioning process and the firm positioning of the tension member on the concrete supporting structure, for example, by means of permanent clamping and/or adhesion.

In the case of a known tensioning device of the type alluded to at the outset (DE 198 49 605 A1), the free end of the strip-shaped tensioning member is clamped into a temporary prestressing anchor, which is moved away in lateral guides by means of pressing elements, such as hydraulic cylinders, for example, by a tensioning traverse that is applied to the base plate in such a way that it can be detached, whereby the tension member is tightened. To establish the final tensioning position, using a block, the

prestressing anchor is braced against the base plate. After the permanent anchoring of the tension member by means of clamping and/or adhesion, the tensioning device is removed.

The prestressing anchor can only be held in a stable position that lies adjacent to the surface of the concrete by virtue of the fact that the lateral guides are connected with the tensioning traverse so as to be deflection resistant, in order to accept the bending stresses that occur toward the top when avoiding the prestressing anchor. This necessitates considerable effort and expense in construction, as a result of which the tensioning device becomes not only heavy and cumbersome, but the requisite space is increased as well, so that a relatively large recess must be produced in the surface of the concrete in order to accommodate the arrangement of the tensioning device.

It is, therefore, the task of the invention to embody a tensioning device of the type alluded to at the outset in such a manner that the prestressing anchor is held stably in its desired position by the forces that occur in the tensioning process, without imposing any flexion stress upon the guides.

According to the invention, this task is resolved by virtue of the fact that a guide body that supports the tension member, which may be glided upward at least is arranged between the tensioning traverse and the prestressing anchor in a stationary manner.

The guide body constitutes, at some distance ahead of the tensioning traverse, a reversal point for the tension member. If one regards the support point of the pressing elements and the lateral guides, guide rods, for example, on the tensioning traverse as an articulation, the prestressing anchor can move only in a circular path whose radius is greater than the distance that exists between the guide body and the prestressing anchor. In order to permit this slewing motion of the prestressing anchor, the tension member would have to be extended, and thus, put under even further tension. The tensile force

exerted by the tension member upon the prestressing anchor therefore holds the prestressing anchor in a stable manner in its prescribed position on the supporting structure, for example, the surface of the concrete, without subjecting the guide rods to any flexion stress in the process. The guide rods, which are subjected to pressure exclusively, can therefore be embodied in relatively slender fashion, since they need not transfer any bending torques. By these means, the tensioning device, overall, becomes light and relatively narrow so that its lateral spatial requirement is slight and the size of the requisite recess in the surface of the supporting structure, the surface of the concrete, for example, is limited.

Since the guide body, which supports the tension member toward the top is arranged in the area of the tension member, and thus does not protrude laterally beyond the guide rods, it does not enlarge the dimensions of the tensioning device.

The guide body preferably accommodates the tension member in a guide slit so that it can glide, so that guidance of the tension member is achieved on all sides.

According to a preferred embodiment of the invention, provision is made so that the guide body is applied to a guide support that is connected to the tensioning traverse so as to be deflection resistant. By these means, the retaining force applied to stabilize the tension member is transferred directly to the tensioning traverse. A separate attachment of the guide body, which would be possible on the concrete supporting structure, for example, becomes non-essential as a result of this embodiment of the thought behind the invention.

Preferably, the guide support is arranged on the top of the tension member and it exhibits lateral sections that protrude laterally beyond the tension member, which are detachably fastened with a shackle that lies beneath the tension member. Thus, the guide body,

which exhibits a guide slit, can be released simply after the tensioning process is terminated and the tension member is secured.

Preferably, provision is made so that the pressing elements lie in the plane of the tension member and so that the supporting of the prestressing anchor using supporting blocks or the like, occurs in the plane of the tension member. By these means, when tension is supplied and support is supplied by blocks, an unstable equilibrium is achieved, which must merely be assured by the guide body, without requiring the guide body to accept significant forces.

In what follows, the invention is elucidated by virtue of one embodiment, which is depicted in the drawing(s).

Fig. 1 shows a strip-shaped tension member applied to a concrete supporting structure with an anchoring device on its fixed side and a tensioning device on its tensioning side, in top view,

Fig. 2 shows a section along the line II-II in Fig. 1,

Fig. 3 shows a section along the line III-III in Fig. 1 and

Fig. 4 shows a schematic representation of the conditions of movement at the tensioning device in a section similar to Fig. 2.

A strip-shaped tension member 1, for example, a carbon fiber reinforced plastic lamella, is intended to be fastened to the surface of a supporting structure, a concrete supporting structure 2 in the case of the embodiment shown. Similarly, use in the case of other supporting structures, made of steel or wood, for example, is also possible. Prior to its fixation to the concrete supporting structure 2, tension member 1 must be pre-stressed.

Tension member 1 is firmly fastened, by means of a clamping plate 3, upon which several clamping shackles have an effect, to a base plate 5, which, by means of pins 6 and an adhesive layer 7, is secured in a recess 8 of the concrete supporting structure at the end that has the fixed side (on the right in Figs. 1 and 2).

In similar fashion, at the end of the tension member 1 on the side subjected to tension (on the left in Figs. 1 and 2), a base plate 9 is secured by means of pins 10 and an adhesive layer 11 in a recess 12 of the concrete supporting structure 2. Before the end of tension member 1 on the side subjected to tension is anchored to the base plate 9, likewise by means of a clamping plate (not yet depicted in Figs. 1 and 2) and, if necessary, before adhesion to the base plate 9, the tension member 1 must be pre-stressed. A tensioning device 13 is used to this end. The tensioning device 13 exhibits a tensioning traverse 14, which is equipped with two straps 15, which are detachably fastened to the base plate 9 on either side of tension member 1 by means of screws 16. Thus, a deflection resistant, detachable connection is created between the tensioning traverse 14 and the base plate 9.

Two pressing elements 17, which are, in the case of the embodiment depicted, embodied as hydraulic cylinders, are supported on the tensioning traverse 14 on the side that is turned away from the base plate 9 (designated in this context as "on the tension side"). Both pressing elements 17 lie in the plane of the tension member 1. They press a prestressing anchor 18 away from the tensioning traverse 14. The prestressing anchor 18 is, on either side, guided on lateral guide rods 19, which are connected with the tensioning traverse 14. The prestressing anchor 18 can be secured, in its tensioning position, to the lateral guide rods 19, so that even after the detachment of the pressing elements 17, it is supported by way of the guide rods 19 on the tensioning traverse 14. Instead of that, another type of support by blocks can be selected as well, in order to support the prestressing anchor. The support or shoring up by blocks in this embodiment lies in the plane of tension member 1 in this embodiment.

The prestressing anchor 18 exhibits a sub-plate 20, upon which the tension member 1 lies. The tension member 1 is clamped by clamping shackle 21, clamping screws 22, and a clamping plate 23 against sub-plate 20 and fastened, in this way, to the prestressing anchor 18.

A guide support 24 is embodied with the tensioning traverse 14 as one piece, welded to the latter or fastened so as to be deflection resistant to the tensioning traverse in some other manner, by means of screws, for example, and [it] constitutes, at its free end, a guide body 25 that lies on the top of the tension member 1, which is located between the tensioning traverse 14 and the prestressing anchor 18 and is arranged at some distance on the tensioning side relative to the tensioning traverse 14.

The guide body 25, which is arranged on the top of the tension member 1, exhibits lateral sections, 26 that protrude laterally beyond tension member 1, which are detachably fastened, preferably by means of lateral screws, 28, with a bracket 27 that lies beneath the tension member 1. The guide body 25 need not necessarily be connected with the tensioning traverse 14: it can also be applied to its location in stationary fashion, connected, for example, with the supporting structure, here, with the concrete supporting structure 2.

A guide slit 29, which accommodates tension member 1 so that it can glide, is constituted between the guide body 25 and the bracket 27.

As represented in schematic fashion in Fig. 4, the guide body 25 constitutes a reversal point for tension member 1, which lies at a distance ahead of the tensioning traverse 14 on the same side as the tension.

If one assumes that the lateral guide rods 19 are applied to the tensioning traverse 14 after the manner of pendulum supports so as to be articulated, the result, for prestressing

anchor 18 is a possibility of movement on a radius  $R$ , which is equal to the distance between the tensioning traverse 14 and the prestressing anchor 18.

For the end of the tension body that protrudes from the guide body 25, the result, however, is a theoretical possibility of movement on a radius  $r$ , which corresponds to the distance between the guide body 25 and the prestressing anchor 18, and is markedly smaller than the radius  $R$ . In order to render a movement of the prestressing anchor 18 possible on a circular path with the structurally prescribed radius of movement  $R$ , the tension member 1 would thus have to be extended further. Thus, the prestressing anchor 18 is found in its location, as depicted in Fig. 4, in a stable position, and it is kept in this stable position without, in the process, necessitating the imposition of any flexion stress upon the lateral guide rods 19.